PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-136416

(43)Date of publication of application : 18.05.2001

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(51)Int.Cl. H04N 5/21

H04N 5/92

H04N 5/93

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(30)Priority

Priority number : 11234369

Priority date : 20.08.1999

Priority country : JP

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(54) SIGNAL PROCESSING UNIT AND METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a signal processing unit that can obtain an optimum noise reduction effect depending on a noise level in the case of reducing noise from a video signal.

SOLUTION: The signal processing unit consists of a motion vector detection circuit 308 that detects a motion vector from an input video signal, a memory controller 306 that generates a motion correction control signal on the basis of

the motion vector corresponding to the input video signal, a noise level detection circuit 310 that detects a noise level of the input video signal on the basis of the result of detection by the motion vector detection circuit 308, a nonlinear processing circuit 303 that applies nonlinear processing with the strength correspondent to the noise level and a 2nd sbutractor 302 that composites the signal subject to nonlinear processing and the input video signal.

LEGAL STATUS [Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] A motion vector detection means to detect an input video-signal lost-motion vector, The motion amendment means which amends by moving to the above-mentioned input video signal based on the motion vector detected with the above-mentioned motion vector detection means, the difference which acquires the differential signal of the signal moved and amended with the above-mentioned motion amendment means, and the above-mentioned input video signal -- with a means A noise level detection means to detect the noise level of the above-mentioned input video signal based on the detection result in the above-mentioned motion vector detection means, the above -- difference --

to the differential signal acquired with the means with a nonlinear-processing means to perform nonlinear processing of the strength according to the noise level detected with the above-mentioned noise level detection means The signal processor characterized by having a synthetic means to compound the signal to which nonlinear processing was performed with the above-mentioned nonlinear-processing means, and the above-mentioned input video signal.

[Claim 2] It is the signal processor according to claim 1 which the above-mentioned motion vector detection means detects the motion vector between the image units which constitute the above-mentioned input video signal, and is characterized [based on the motion vector which detected the above-mentioned motion amendment means with the above-mentioned motion vector detection means] by to amend by moving by the above-mentioned motion vector to the dynamic body which extracted the dynamic body and extracted from the above-mentioned input video signal in front of 1 image unit.

[Claim 3] The above-mentioned image unit is a signal processor according to claim 2 characterized by being a frame or the field.

[Claim 4] The above-mentioned motion vector detection means is a signal processor according to claim 1 characterized by dividing the above-mentioned input video signal into a block, and detecting a motion vector to each block.

[Claim 5] The above-mentioned noise level detection means is the signal

processor according to claim 4 carry out having a conversion means in the strength change the noise level graduated by filter means perform filtering which graduates time fluctuation of the noise level of the average which detected with an average level detection means detect an average noise level based on the motion vector detected to each block, and the above-mentioned average level detection means, and the above-mentioned filter means to the strength of nonlinear processing in the above-mentioned nonlinear-processing means as the description.

[Claim 6] The above-mentioned filter means is a signal processor according to claim 5 characterized by fitting a property to the accuracy of the noise detection in the above-mentioned noise level detection means.

[Claim 7] the difference of the motion vector by which the above-mentioned noise level detection means was detected to each block -- with an average level detection means to detect an average noise level based on a value A judgment means with a beam to judge existence with the beam of the signal within 1 image unit from the noise level of the average detected with the above-mentioned average level detection means, The signal processor according to claim 4 characterized by having a filter means to perform filtering which carries out the mask of the input when time fluctuation of the average noise level from the above-mentioned average level detection means is

graduated and it is judged with a beam with owner ** by the above-mentioned judgment means with a beam.

[Claim 8] A judgment means with a beam to judge existence with the beam of a signal for every block based on the minimum value of the difference of the motion vector by which the above-mentioned noise level detection means was detected to each block, An average level detection means to detect an average noise level based on the motion vector detected for every block about the block stretched with the above-mentioned judgment means with a beam, stuck, and judged that is nothing, The signal processor according to claim 4 characterized by having a filter means to perform filtering which graduates time fluctuation of the noise level of the average detected with the above-mentioned average level detection means.

[Claim 9] A motion vector detection means to detect an input video-signal lost-motion vector, The motion amendment means which amends by moving to the above-mentioned input video signal based on the motion vector detected with the above-mentioned motion vector detection means, the difference which acquires the differential signal of the signal and the above-mentioned input video signal which were moved and amended with the above-mentioned motion amendment means -- with a means the above -- difference -- with an orthogonal transformation means to change into a frequency band the differential signal

acquired with the means A noise level detection means to detect the noise level of the above-mentioned input video signal based on the detection result in the above-mentioned motion vector detection means, A nonlinear-processing means to perform nonlinear processing of the strength according to the noise level detected in the above-mentioned noise level detection means for every frequency band to the signal changed into the frequency band with the above-mentioned orthogonal transformation means, The signal processor characterized by having a synthetic means to compound the signal to which nonlinear processing was performed with the above-mentioned nonlinear-processing means, and the above-mentioned input video signal.

[Claim 10] It is the signal processor according to claim 9 which the above-mentioned motion vector detection means detects the motion vector between the image units which constitute the above-mentioned input video signal, and is characterized [based on the motion vector which detected the above-mentioned motion amendment means with the above-mentioned motion vector detection means] by to amend by moving by the above-mentioned motion vector to the dynamic body which extracted the dynamic body and extracted from the above-mentioned input video signal in front of 1 image unit.

[Claim 11] The above-mentioned image unit is a signal processor according to claim 10 characterized by being a frame or the field.

[Claim 12] The above-mentioned motion vector detection means is a signal processor according to claim 9 characterized by dividing the above-mentioned input video signal into a block, and detecting a motion vector to each block.

[Claim 13] The above-mentioned noise level detection means is the signal processor according to claim 12 carry out having a conversion means in the strength change the noise level graduated by filter means perform filtering which graduates time fluctuation of the noise level of the average which detected with an average level detection means detect an average noise level based on the motion vector detected to each block, and the above-mentioned average level detection means, and the above-mentioned filter means to the strength of nonlinear processing in the above-mentioned nonlinear-processing means as the description.

[Claim 14] The above-mentioned filter means is a signal processor according to claim 13 characterized by fitting a property to the accuracy of the noise detection in the above-mentioned noise level detection means.

[Claim 15] the difference of the motion vector by which the above-mentioned noise level detection means was detected to each block -- with an average level detection means to detect an average noise level based on a value A judgment means with a beam to judge existence with the beam of the signal within 1 image unit from the noise level of the average detected with the

above-mentioned average level detection means, The signal processor according to claim 12 characterized by having a filter means to perform filtering which carries out the mask of the input when time fluctuation of the average noise level from the above-mentioned average level detection means is graduated and it is judged with a beam with owner ** by the above-mentioned judgment means with a beam.

[Claim 16] A judgment means with a beam to judge existence with the beam of a signal for every block based on the minimum value of the difference of the motion vector by which the above-mentioned noise level detection means was detected to each block, An average level detection means to detect an average noise level based on the motion vector detected for every block about the block stretched with the above-mentioned judgment means with a beam, stuck, and judged that is nothing, The signal processor according to claim 12 characterized by having a filter means to perform filtering which graduates time fluctuation of the noise level of the average detected with the above-mentioned average level detection means.

[Claim 17] Detect an input video-signal lost-motion vector, and the above-mentioned input video signal is received. The signal by which motion amendment was carried out [above-mentioned] by amending by moving based on the detected motion vector, Acquire a differential signal with the

above-mentioned input video signal, detect the noise level of the above-mentioned input video signal based on the detection result of the above-mentioned motion vector, and the above-mentioned differential signal is received. The signal-processing approach characterized by compounding the signal with which nonlinear processing of the strength according to the detected noise level was performed, and the above-mentioned nonlinear processing was performed, and the above-mentioned input video signal.

[Claim 18] The signal-processing approach according to claim 17 which detects the motion vector between the image units which constitute the above-mentioned input video signal, and is characterized by amending based on the detected motion vector by moving by the above-mentioned motion vector to the dynamic body which extracted and extracted the dynamic body from the above-mentioned input video signal in front of 1 image unit.

[Claim 19] The above-mentioned image unit is the signal-processing approach according to claim 18 characterized by being a frame or the field.

[Claim 20] The signal-processing approach according to claim 17 characterized by dividing the above-mentioned input video signal into a block, and detecting a motion vector to each block.

[Claim 21] the difference of the motion vector by which the above-mentioned noise level detection was detected to each block -- the signal-processing

approach according to claim 20 which detects an average noise level based on a value, and is characterized by to perform filtering which carries out the mask of the input when existence with the beam of the signal within 1 image unit judged from the average noise level which carried out [above-mentioned] detection, and time fluctuation of the above-mentioned average noise level graduates and it is judged with a beam with owner ** by the above-mentioned judgment with a beam.

[Claim 22] It is the signal-processing approach according to claim 20 of carrying out graduating the time fluctuation of an average noise level which detected the average noise level and carried out [above-mentioned] detection based on the motion vector detected for every block about the block the above-mentioned noise level detection judged existence with the beam of a signal for every block based on the minimum value of the difference of the motion vector detected to each block, and it stretched by the above-mentioned judgment with a beam, attached it, and were judged that is nothing as the description.

[Claim 23] Detect an input video-signal lost-motion vector, and the above-mentioned input video signal is received. Amend by moving based on the detected motion vector, and the differential signal of the signal and the above-mentioned input video signal by which motion amendment was carried out [above-mentioned] is acquired. As opposed to the signal which changed the

above-mentioned differential signal into the frequency band, detected the noise level of the above-mentioned input video signal based on the detection result of the above-mentioned motion vector, and was changed into the above-mentioned frequency band The signal-processing approach characterized by having compounding the signal with which nonlinear processing of the strength according to the noise level detected in the above-mentioned noise level detection was performed for every frequency band, and the above-mentioned nonlinear processing was performed, and the above-mentioned input video signal.

[Claim 24] The signal-processing approach according to claim 23 which detects the motion vector between the image units which constitute the above-mentioned input video signal, and is characterized by amending based on the detected motion vector by moving by the above-mentioned motion vector to the dynamic body which extracted and extracted the dynamic body from the above-mentioned input video signal in front of 1 image unit.

[Claim 25] The above-mentioned image unit is the signal-processing approach according to claim 24 characterized by being a frame or the field.

[Claim 26] The signal-processing approach according to claim 23 characterized by dividing the above-mentioned input video signal into a block, and detecting a motion vector to each block.

[Claim 27] the difference of the motion vector by which the above-mentioned noise level detection was detected to each block -- the signal-processing approach according to claim 26 which detects an average noise level based on a value, and is characterized by to perform filtering which carries out the mask of the input when existence with the beam of the signal within 1 image unit judged from the average noise level which carried out [above-mentioned] detection, and time fluctuation of the above-mentioned average noise level graduates and it is judged with a beam with owner ** by the above-mentioned judgment with a beam.

[Claim 28] It is the signal-processing approach according to claim 26 of carrying out graduating the time fluctuation of an average noise level which detected the average noise level and carried out [above-mentioned] detection based on the motion vector detected for every block about the block the above-mentioned noise level detection judged existence with the beam of a signal for every block based on the minimum value of the difference of the motion vector detected to each block, and it stretched by the above-mentioned judgment with a beam, attached it, and were judged that is nothing as the description.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the signal processor and the approach that noise reduction processing of a video signal is performed.

[0002]

[Description of the Prior Art] The round mold noise reduction equipment which used the frame memory What mitigates a noise by performing equalization processing between the fields is known for the field of digital video-signal processing. Extract the part of the small level of the differences of an input video signal and the video signal one frame before a frame memory as a noise, and by subtracting the extracted noise component from an input video signal What writes the signal with which the noise was reduced and the noise was reduced in a frame memory is proposed. In addition, capacity of memory can be lessened if a field memory is used instead of a frame memory.

[0003] Drawing 15 shows an example of conventional noise reduction equipment. The input video signal Vin changed into the digital signal from the input terminal 201 is supplied, and this input video signal Vin is supplied to the 1st subtractor 202 and 2nd subtractor 204. While the output video signal Vout of the 1st

subtractor 202 is taken out by the output terminal 207, it is written in a frame memory 205. The memory controller 206 is formed in relation to the frame memory 205. The memory controller 206 is for controlling write-in actuation and read-out actuation of a frame memory 205, and one read-out data of a frame memory 205 is delayed to write-in data. If one-frame delay is expressed with F-1, output signal Vout and F-1 of a frame memory 205 will be supplied to the 2nd subtractor 204. since the input video signal Vin is supplied in the 2nd subtractor 204 -- a frame -- difference occurs.

[0004] The output video signal of the 2nd subtractor 204 is supplied to the 1st subtractor 202 through the nonlinear-processing circuit 203. The nonlinear-processing circuit 203 multiplies by the feedback multiplier K according to the level of an input signal, and is constituted by ROM (read-only memory). the range where the input-output behavioral characteristics of the nonlinear-processing circuit 203 have a small input (frame difference) -- as K= 1 -- an input -- as a noise component -- outputting -- an input -- the range of in-between level -- an output -- a predetermined value -- restricting -- the range where an input is large -- an output -- small -- carrying out -- time an input is still larger -- a frame -- difference is setting the output to 0 as what was generated by motion.

[0005] Thus, the nonlinear-processing circuit 203 extracts a noise component

using the property that the inter-frame correlation of a noise component is small, and it is small-size width of face. In the 1st subtractor 202, a noise can be reduced by subtracting the extracted noise component from an input video signal.

[0006] output video signal Vout from noise reduction equipment **

$$
\begin{aligned}
Vout &= Vin - K \cdot (Vin - Vout \cdot F^{-1}) \\
&= Vin \cdot (1 - K) / (1 - K \cdot F^{-1})
\end{aligned}
$$

It can come out and express.

[0007] As mentioned above, in conventional noise reduction equipment, from difference with the video signal before [one] reading from an input video signal and a frame memory, the component of small-size width of face is extracted as a noise, and a noise is reduced by subtracting from an input video signal.

[0008] Moreover, in conventional noise reduction equipment, the video signal which reduced this noise is written in a frame memory, and it uses for processing of the following frame. If the autocorrelation between the fields is used instead of a frame, a configuration with the same said of not a frame memory but a field memory is possible.

[0009]

[Problem(s) to be Solved by the Invention] By the way, the noise reduction effectiveness is low or above-mentioned noise reduction equipment has the

problem that the noise reduction effectiveness of a certain frequency band is low, even if the video signal of a big noise level is inputted, in order not to be based on the noise level or frequency distribution which were inputted but to use the same nonlinear-processing circuit. On the contrary, when a noise hardly exists, there is a problem of being as a noise increasing conversely **** [, and]. [that the motion dotage of a block and field correlation whose motion vector detection was not completed is conspicuous]

[0010] Moreover, depending on the magnitude of the dynamic range of an input signal, the value of the high amplitude of a video signal or the low amplitude may be stretched and attached to a fixed value. Since a noise does not exist in the part stretched and attached when the signal stretched and attached to such a fixed value exists, when there is no noise in the original video signal, it will incorrect-detect. This invention is proposed in view of the above-mentioned actual condition, reduces a noise also from the video signal of a big noise level, reduces a noise also from each frequency band, also when a noise hardly exists, it can reduce a noise so that image quality may not deteriorate, and it aims at offering the signal processor and approach of preventing the incorrect detection by having no noise when a signal stretched and sticks.

[0011]

[Means for Solving the Problem] In order to solve an above-mentioned technical

problem, the signal processor concerning this invention A motion vector detection means to detect an input video-signal lost-motion vector, The motion amendment means which amends by moving to the above-mentioned input video signal based on the motion vector detected with the above-mentioned motion vector detection means, the difference which acquires the differential signal of the signal moved and amended with the above-mentioned motion amendment means, and the above-mentioned input video signal -- with a means A noise level detection means to detect the noise level of the above-mentioned input video signal based on the detection result in the above-mentioned motion vector detection means, the above -- difference -- it has a synthetic means to compound a nonlinear-processing means to perform nonlinear processing of the strength according to the noise level detected with the above-mentioned noise level detection means, and the signal, to which nonlinear processing was performed with the above-mentioned nonlinear-processing means and the above-mentioned input video signal, to the differential signal acquired with the means.

[0012] Moreover, a motion vector detection means by which the signal processor concerning this invention detects an input video-signal lost-motion vector, The motion amendment means which amends by moving to the above-mentioned input video signal based on the motion vector detected with the

above-mentioned motion vector detection means, the difference which acquires the differential signal of the signal and the above-mentioned input video signal which were moved and amended with the above-mentioned motion amendment means -- with a means the above -- difference -- with an orthogonal transformation means to change into a frequency band the differential signal acquired with the means A noise level detection means to detect the noise level of the above-mentioned input video signal based on the detection result in the above-mentioned motion vector detection means, A nonlinear-processing means to perform nonlinear processing of the strength according to the noise level detected in the above-mentioned noise level detection means for every frequency band to the signal changed into the frequency band with the above-mentioned orthogonal transformation means, It has a synthetic means to compound the signal to which nonlinear processing was performed with the above-mentioned nonlinear-processing means, and the above-mentioned input video signal.

[0013] The signal-processing approach concerning this invention detects an input video-signal lost-motion vector, and receives the above-mentioned input video signal. The signal by which motion amendment was carried out [above-mentioned] by amending by moving based on the detected motion vector, Acquire a differential signal with the above-mentioned input video signal,

detect the noise level of the above-mentioned input video signal based on the detection result of the above-mentioned motion vector, and the above-mentioned differential signal is received. The signal and the above-mentioned input video signal with which nonlinear processing of the strength according to the detected noise level was performed, and the above-mentioned nonlinear processing was performed are compounded.

[0014] Moreover, the signal-processing approach concerning this invention detects an input video-signal lost-motion vector, and receives the above-mentioned input video signal. Amend by moving based on the detected motion vector, and the differential signal of the signal and the above-mentioned input video signal by which motion amendment was carried out [above-mentioned] is acquired. As opposed to the signal which changed the above-mentioned differential signal into the frequency band, detected the noise level of the above-mentioned input video signal based on the detection result in the above-mentioned motion vector detection means, and was changed into the above-mentioned frequency band The signal and the above-mentioned input video signal with which nonlinear processing of the strength according to the noise level detected in the above-mentioned noise level detection means was performed for every frequency band, and the above-mentioned nonlinear processing was performed are compounded.

[0015] It is desirable to use for noise level detection only the block which carries out the mask of the input of noise level detection to every [which judged whether it was in the input signal with the beam here for every block at the time of dividing 1 image unit (the field or frame) or an input video signal into a block, and existed with the beam] image unit (the field or frame), or sticks it on it, and attaches it to it and which is not.

[0016]

[Embodiment of the Invention] Hereafter, it explains, referring to a drawing about the gestalt of implementation of this invention. First, an example of the optical disk record regenerative apparatus which can apply this invention is explained with reference to drawing 1 .

[0017] In drawing 1 the recording system of the optical disk record regenerative apparatus 1 The A/D-conversion circuit 102 where a picture signal is inputted from an input terminal 101, The NTSC (National Television System Committee) decoder 103 into which image data is inputted from the A/D-conversion circuit 102, The noise reduction circuit 104 where an image is inputted from the NTSC decoder 103, The MPEG (Moving Picture Experts Group) encoder 105 into which image data is inputted from the noise reduction circuit 104, The ECC (Error Correction Codes) encoder 106 into which image data is inputted from the MPEG encoder 105, It consists of 8 -14 modulation circuit 107 where image data

is inputted from the ECC encoder 106, and RF amplifier 108 into which image data is inputted from 8 -14 modulation circuit 107.

[0018] The picture signal of NTSC system is inputted from an input terminal 101, and the A/D-conversion circuit 102 performs A/D-conversion processing. This A/D-conversion processing circuit 102 is performing A/D-conversion processing, and makes the picture signal of an analog digital image data. And this A/D-conversion circuit 102 inputs image data into the NTSC decoder 103.

[0019] The image data of NTSC system is inputted into the NTSC decoder 103 from the A/D-conversion circuit 102. This NTSC decoder 103 performs decoding to the composite signal of NTSC system. This NTSC decoder 103 is performing decoding, and changes image data into baseband signaling (a luminance signal, a R-Y signal, B-Y signal). And this NTSC decoder 103 outputs image data to the noise reduction circuit 104.

[0020] Image data is inputted into the noise reduction circuit 104 from the NTSC decoder 103. This noise reduction circuit 104 performs reduction processing of the random noise contained in the input video signal. This noise reduction circuit 104 is performing noise reduction processing, and it raises motion compensation predictability while it raises the picture compression effectiveness in the latter MPEG encoder 105. Noise reduction processing is performed to all components, or is performed only to a luminance signal. The noise reduction circuit 104 is

performing filtering processing, and performs noise reduction processing to the image data sent from the NTSC decoder 103. Moreover, it connects with the control circuit 120 and this noise reduction circuit 104 operates according to the control signal sent from this control circuit 120. A control circuit 120 is considered as the configuration of a microcomputer. And this noise reduction circuit 104 outputs image data to the MPEG encoder 105. The noise reduction circuit 104 of the gestalt of this operation extracts the noise component except a motion, and reduces a noise by choosing the optimal nonlinear circuit according to a noise level.

[0021] The MPEG encoder 105 performs motion compensation inter-frame predicting coding to the image data sent from the noise reduction circuit 104, and performs block DCT (Discrete Cosine Transformation: discrete cosine transform) coding processing to a prediction error. This MPEG encoder 105 is performing coding processing to image data, and let it be the image data of an MPEG method. At this time, with the MPEG encoder 105, encoded information, such as a quantization scale, is added to image data, for example, and it considers as a bit stream. And this MPEG encoder 105 outputs image data to the ECC encoder 106.

[0022] The ECC encoder 106 adds the redundancy data of an error condition to the bit stream sent from the MPEG encoder 105. And this ECC encoder 106

outputs this bit stream to eight to 14 modulation circuit 107.

[0023] 8 -14 modulation circuit 107 performs signal processing, such as eight to 14 modulation, to the bit stream sent from the ECC encoder 106. 8 -14 modulation changes a 8-bit code into 14-bit data, in order to lessen the low-pass frequency component of a record signal. 8 -14 modulation circuit 107 outputs the bit stream which performed 8 -14 modulation and other processings to RF amplifier 108. RF amplifier 108 performs magnification processing to the bit stream sent from 8 -14 modulation circuit 107, and outputs it to an optical pickup 109.

[0024] And the recording system of this optical disk record regenerative apparatus 1 records the bit stream which shows an image to an optical disk 110 through an optical pickup 109. An optical disk 110 is recordable and optical disks, such as a magneto-optic disk and a phase change mold disk, can be used for it.

[0025] Moreover, the reversion system of the optical disk record regenerative apparatus 1 records the bit stream which shows an image for the image data recorded on the optical disk 110 through an optical pickup 109. An optical disk 110 is recordable and optical disks, such as a magneto-optic disk and a phase change mold disk, can be used for it.

[0026] Moreover, the reversion system of the optical disk record regenerative apparatus 1 RF amplifier 111 into which the image data recorded on the optical

disk 110 is inputted through an optical pickup 109, The MPEG decoder 114 into which image data is inputted from the ECC decoder 113 into which image data is inputted, and the ECC decoder 113 from 8 -14 demodulator circuit 112 where image data is inputted from RF amplifier 111, and 8 -14 demodulator circuit 112, The noise reduction circuit 115 where image data is inputted from the MPEG decoder 114, The image quality amendment circuit 116 where the image data by which the noise was controlled from the noise reduction circuit 115 is inputted, It consists of an NTSC encoder 117 into which the image data by which image amendment was made from the image quality amendment circuit 116 is inputted, and a D/A conversion circuit 118 into which the image data of NTSC system is inputted from the NTSC encoder 117.

[0027] RF amplifier 111 performs magnification processing to the image data sent from the optical disk 110 detected by the optical pickup 109. Moreover, although omitted in drawing 1 , a tracking error signal and a focal error signal are generated in RF amplifier 111 for a tracking servo and a focus servo. These tracking error signals and a focus servo signal are supplied to a servo circuit. RF amplifier 111 outputs the image data which performed magnification processing to eight to 14 demodulator circuit 112.

[0028] 8 -14 demodulator circuit 112 performs 8-14 recovery processing to the image data sent from RF amplifier 111. 8 -14 demodulator circuit 112 cconverts

14-bit data with a 8-bit code at eight to 14 modulation and reverse of a recording system. This 8 -14 demodulator circuit 112 outputs the image data which performed recovery processing to the ECC decoder 113.

[0029] The ECC decoder 113 performs decoding to the image data sent from 8 -14 demodulator circuit 112. That is, the error included in playback data is detected and the error which can be corrected is corrected. And this ECC decoder 113 outputs the image data which performed error correction processing to the MPEG decoder 114. By MPEG, a coder 114 decodes MPEG and outputs baseband signaling. The MPEG decoder 114 outputs baseband signaling to the noise reduction circuit 115.

[0030] The noise reduction circuit 115 is performing filtering processing, and performs noise reduction processing to the image data sent from the MPEG decoder 114. This noise reduction circuit 115 is performing noise reduction processing, and reduces the mosquito noise and block distortion which were produced by having performed decoding by the MPEG decoder 114. Moreover, it connects with the control circuit 120 and this noise reduction circuit 115 is controlled according to the control signal sent from this control circuit 120. And in this noise reduction circuit 115, the image data which performed noise reduction processing is outputted to the image quality amendment circuit 116.

[0031] The noise reduction circuit 115 of the gestalt of this operation extracts the

noise component except a motion, and reduces a noise by choosing the optimal nonlinear circuit according to a noise level.

[0032] The image quality amendment circuit 116 performs image quality amendment processing to the image data sent from the noise reduction circuit 115. This image quality amendment circuit 116 performs for example, profile amendment processing etc. as image quality amendment processing. Moreover, it connects with the control circuit 120 mentioned later, and this image quality amendment circuit 116 is controlled according to the control signal sent from this control circuit 120. And this image quality amendment circuit 116 outputs the image data which performed image quality amendment processing to the NTSC encoder 117.

[0033] The NTSC encoder 117 processes addition of a synchronizing signal, the modulation of a color-difference signal, etc. to the image data sent from the image quality amendment circuit 116. This NTSC encoder 117 is performing encoding processing, and changes image data into the decode video signal of NTSC system. And this NTSC encoder 117 outputs an NTSC video signal to the D/A conversion circuit 118.

[0034] The D/A conversion circuit 118 performs D/A transform processing to the image data sent from the NTSC encoder 117. This D/A conversion circuit 118 is performing D/A transform processing, and generates the decode video signal of

the NTSC system of an analog. And this D/A conversion circuit 118 outputs the picture signal which performed D/A transform processing to an output terminal 119.

[0035] In relation to the control circuit 120 which supplies a control signal to the noise reduction circuit 104, the noise reduction circuit 115, and the image quality amendment circuit 116 which were mentioned above, the actuation input section 121 which is operated by the user and supplies an input signal to a control circuit 120 is formed.

[0036] A control circuit 120 consists of microcomputers etc. and supplies a control signal to the noise reduction circuit 104, the above-mentioned noise reduction circuit 115, and the above-mentioned image quality amendment circuit 116. A control circuit 120 supplies the control signal for reducing block distortion, corresponding to the input signal sent from the actuation input section 121 to the noise reduction circuit 115. Moreover, a control circuit 120 supplies the control circuit which shows whether image quality amendment is performed, and the control signal which shows extent of image quality amendment to the image quality amendment circuit 116.

[0037] The actuation input section 121 carries out the generation output of the input signal by a switch etc. being pressed alternatively, when a user etc. performs ON / off control of block distortion reduction. Moreover, the switch

whose user can control extent of image quality amendment is formed, and this actuation input section 121 carries out the generation output of the input signal because a user presses a switch alternatively.

[0038] The gestalt of this operation is applied like the noise reduction circuit 104 or the noise reduction circuit 115 in the record regenerative apparatus mentioned above for noise reduction. In addition, this invention is applicable also to the record regenerative apparatus which uses record media other than an optical disk. Furthermore, also when communicating image data, it can apply.

[0039] The gestalt of operation of the 1st of the noise reduction circuit where this invention was applied is shown in drawing 2 . The gestalt of operation of the 1st of noise reduction equipment is the noise level ecad field round mold noise reduction circuit in which the noise level detector 310 which detects the noise level of an input video signal was established. In the noise level detector 310, since the optimal nonlinear-processing circuit 303 is chosen as automatic according to the detected noise level, according to the strength of the inputted noise, the amount of feedback is controllable.

[0040] This noise reduction equipment has the motion vector detector 308 which detects the video-signal lost-motion vector of which 1 field +beta delay was done by the 1st field memory 309 which accumulates the 1 field of video signals inputted from the input terminal 301, the video signal sent from the terminal 301,

and the 1st field memory 309.

[0041] The video signal changed into the digital signal is supplied to an input terminal 301. And this input video signal Vin is inputted into the motion vector detector 308 at the same time it is written in the 1st field memory 309. In the motion vector detector 308, it asks for the motion vector of each block with the video signal inputted from the input terminal 301, and the video signal which was read from the 1st field memory 309 and of which 1 field +beta delay was done.

[0042] Moreover, noise reduction equipment has the 2nd field memory 305 which accumulates the 1 field of video signals outputted from an output terminal 307, and the memory controller 306 which controls the 2nd field memory 305 based on the motion vector detected in the motion vector detector 308.

[0043] The motion vector obtained from the motion vector detector 308 is inputted into the memory controller 306, and the 1 field will be delayed by the time it is outputted from the memory controller 306 as a motion amendment control signal. In order to double delay of the 1 field of this motion amendment control signal, a video signal is inputted, and 1 field +beta delay of it is carried out, and it is read to the 1st field memory 309. According to this video signal of which 1 field +beta delay was done, the video signal which was sent from the memory controller 306 and of which was moved and 1 field +alpha delay was done from the 2nd field memory 305 according to the amendment control signal

is read.

[0044] Furthermore, noise reduction equipment has the 2nd subtractor 302 compounded by reducing the video signal sent from the 1st subtractor 304 which subtracts the video signal sent from the 2nd video signal 305 from the video signal sent from the 1st field memory 309, and acquires a differential signal, the nonlinear-processing circuit 303 which performs nonlinear processing to the differential signal sent from the 1st subtractor 304, and the nonlinear-processing circuit 303 from the video signal sent from the 1st field memory 309.

[0045] In the 1st subtractor 304, the field differential signal of the video signal which was sent from the 1st field memory 309 and of which 1 field +beta delay was done, and the video signal which was sent from the 2nd field memory 305 and of which 1 field +alpha delay was done is acquired.

[0046] In the nonlinear-processing circuit 303, nonlinear processing is performed and, as for this field differential signal, a noise component is extracted. The signal processed in the nonlinear-processing circuit 303 is compounded with the video signal sent from the 1st field memory 309 with the 2nd subtractor 302, and is outputted from an output terminal 307.

[0047] And noise reduction equipment detects a noise level based on the detection result in the motion vector detector 308, and has the noise level detector 310 which controls the nonlinear-processing circuit 303 according to

this noise level.

[0048] The minimum value of the difference of block matching of the motion vector for every block obtained from the motion vector detector 308, and effective / invalid judging of motion vector detection are inputted into the noise level detector 310.

[0049] The noise level detector 310 measures the average noise level of a video signal, changes and outputs it to the limiter level of N phase, and is inputted into the nonlinear-processing circuit 303. About the processing in this noise level detector 310, it mentions later further.

[0050] In the nonlinear-processing circuit 303, nonlinear processing according to the limiter level of N phase where it was inputted from the noise level detector 310 is chosen from processing of N individual, and the nonlinear processing is performed. The property of nonlinear processing of N individual is realized by two or more memory (ROM or RAM) tables.

[0051] The noise extracted as a noise is subtracted from an input video signal with the 2nd subtractor 302 by performing processing in the nonlinear-processing circuit 303. Thus, the noise level ecad field round mold noise reduction circuit 104 which reduces a noise consists of input video signals.

[0052] Next, in the noise level detector 310, an average noise level is measured from effective / invalid judging of the minimum value of the difference of block

matching for every block, and detection, and how to output the limiter level according to a noise level is explained using drawing 3 .

[0053] Effective / invalid judging result 401 for every block obtained from the motion vector detector 308 are inputted into the minimum value detecting element 403. And the minimum value of the minimum value of the difference of block matching of a motion vector is calculated only using the minimum value of the difference of block matching of the block judged that is effective.

[0054] By using only the minimum value of the difference of block matching of the motion vector judged as motion vector detection being effective, it is possible to extract the difference of only the noise except the difference by motion.

[0055] In addition, as detection of the minimum value in the minimum value detecting element 403, the one minimum value may be calculated in the field, and it is very good in the average of two or more minimum values, and very good in the average of the minimum value in each area divided in the field.

[0056] The noise extracted by the minimum value detecting element 403 is inputted into a filter 405. A filter 405 performs an infinity impulse response (infiniteimpulse response; IIR) in the circuit shown in drawing 4 .

[0057] The filter 405 shown in drawing 4 has the adder 504 which adds the 1st amplifier 503 which amplifies a noise level 501 1-K times, the delay section 506 to which unit time delay of the average noise level 507 is carried out, the 2nd

amplifier 505 which amplifies the output from the delay section 506 K times, the output from the 1st amplifier 503, and the output from the 2nd amplifier 505, and is made into an average noise level. In addition, the 1st amplifier 503 can also regard the multiplier multiplier which carries out the multiplication of the multiplier 1-K, and the 2nd amplifier 505 as the multiplier multiplier which carries out the multiplication of the multiplier K.

[0058] Here, it depends for amplification factor 1-K in the 1st amplifier 503, and the amplification factor K in the 2nd amplifier 505 on the accuracy 502 of noise level detection. The relation between filter coefficient K and the accuracy 502 of noise level detection is mentioned further later. In addition, IIR with a transfer function which is not limited to IIR of the circuit shown in drawing 4 , and is different is sufficient as the filter 405 used here, and it may be a median filter.

[0059] The accuracy of the noise level determined in the accuracy decision section 404 of noise level detection is inputted into a filter 405, and the value of the multiplier K of the 1st amplifier 503 and the 2nd amplifier 505 is adaptively changed according to this accuracy.

[0060] The accuracy of a noise level and the relation of a multiplier K are shown in drawing 5 . As shown in drawing 5 , when the accuracy of noise level detection is 0, filter factor K is 1. Filter factor K decreases in monotone as the accuracy of noise level detection increases. When the accuracy of noise level detection is 1,

filter factor K is about 0.

[0061] The more the accuracy of a noise level is low, the more the information on the field is controlled. Effective / invalid judging result 401 for every block are inputted into the accuracy decision section 404 of noise level detection, the effective block count is counted in it, and the accuracy = effective block count / the number of whole blocks is outputted to it as accuracy of noise level detection. In addition, the decision approach of the accuracy of noy gap ** RU is not restricted to this approach.

[0062] The noise level outputted from the filter 405 is inputted into the limiter level-conversion section 406, and is changed into the limiter level of the strength of N phase.

[0063] As explained above, in the gestalt of operation of the 1st of noise reduction equipment, the average noise level of the inputted noise is extracted, the optimal nonlinear-processing circuit according to this extracted noise level is chosen as automatic, and noise reduction according to the strength of the inputted noise is performed.

[0064] Next, the gestalt of the operation of the 2nd of noise reduction equipment which used orthogonal transformation like a Hadamard transform for the extract of a noise is explained. The gestalt of the 2nd operation is motion ecad field round mold noise reduction equipment which measures the noise level of each

frequency component automatically, and controls the amount of feedback for every frequency component accommodative according to the noise level.

[0065] Here, the configuration of the noise reduction equipment (noise reducer) which will be the requisite for the gestalt of operation of the 2nd of noise reduction equipment is explained with reference to drawing 6 . This noise reduction equipment forms the recursive filter conventionally known for the field of digital image signal processing, and performs equalization processing between the fields, and the frame memory which mitigates a noise is used for it.

[0066] In order to enable removal of the noise component which it became independent of for every evasion of motion dotage when a motion is in an image, or frequency component, after the noise reduction equipment which will be the requisite for the gestalt of this operation divides into a wave number component further a differential signal with the present signal acquired by motion amendment two or more rounds by orthogonal transformation, it performs and carries out reverse orthogonal transformation of the nonlinear processing, respectively, and obtains a noise component.

[0067] The video signal changed into the digital signal from the input terminal 1 is supplied, and this input video signal Vin is inputted into the motion vector detector 8 at the same time it is written in the 1st field memory 9. The video signal delayed about 1 field is read from the 1st field memory 9. Correctly, in

addition to the 1 field, time amount beta delay of the video signal read from the 1st field memory 9 is done further. This time amount beta is used for timing adjustment etc.

[0068] In the motion vector detector 8, it asks for the motion vector of a block with the video signal inputted from the terminal 1, and the video signal read from the 1st field memory 9.

[0069] By the time the motion vector obtained from the motion vector detector 8 is inputted into the memory controller 6 and outputted from the memory controller 6 as a motion amendment control signal, about 1 field will be delayed.

[0070] The video signal outputted from an output terminal 7 is written in the 2nd field memory 5 per field. About 1 field delay ******** of the video signal written in the 2nd field memory 5 is carried out to the video signal from the 1st field memory 9, and difference with the video signal from the 1st field memory 9 is taken with the 1st subtractor 4.

[0071] That is, according to the video signal from the 1st field memory 9, the video signal with which motion compensation processing was performed is read from the 2nd field memory. A field differential signal is acquired from the video signal read from the 1st field memory 9, and the video signal read from the 2nd field memory 5 with the 1st subtractor 4.

[0072] The memory controller 6 controls read-out of the video signal from the

2nd field memory 5 based on the motion vector detected in the motion vector detector 8 to compensate a motion of an input video signal.

[0073] In addition, as for a video signal, in addition to the 1 field, in the 2nd field memory 5, only time amount alpha is delayed further correctly. This time amount alpha is used for timing adjustment etc.

[0074] The field differential signal acquired with the 1st subtractor 4 is inputted into the Hadamard transform circuit 10. The Hadamard transform circuit 10 performs a Hadamard transform, and performs orthogonal transformation which divides a field differential signal to a predetermined frequency component.

[0075] Each frequency component passes along the nonlinear-processing circuit 13, respectively, and the noise component for every frequency band is extracted. The nonlinear-processing circuit 13 multiplies by the feedback multiplier K according to the level for every frequency band of an input signal.

[0076] the range where the input-output behavioral characteristics of the nonlinear-processing circuit 13 have a small input (field difference) -- as K= 1 -- an input -- as a noise component -- outputting -- an input -- the range of in-between level -- an output -- a predetermined value -- restricting -- the range where an input is large -- an output -- small -- carrying out -- time an input is still larger -- the field -- difference is setting the output to 0 as what was generated by motion.

[0077] The noise extracted by nonlinear processing in the nonlinear-processing circuit 13 is returned to the signal on time amount by the reverse Hadamard transform circuit 11. And in the 2nd subtractor 2, it is compounded so that a noise may be removed from the video signal sent from the 1st field memory 9.

[0078] This noise reduction equipment can reduce motion dotage in case there are two or more motions in a screen using motion amendment and orthogonal transformation.

[0079] The gestalt of operation of the 2nd of noise reduction equipment reduces a noise by extracting the noise component except a motion on the assumption that such noise reduction equipment, and choosing the optimal nonlinear-processing circuit according to a noise level. That is, the gestalt of this operation detects the noise level of an input video signal, and it is made to make nonlinear processing apply adaptively in above-mentioned noise reduction equipment according to this noise level.

[0080] Drawing 7 is the block diagram of the gestalt of operation of the 2nd of noise reduction equipment. In the gestalt of operation of the 2nd of noise reduction equipment, it is the same as that of the configuration in the gestalt of the 1st operation shown in drawing 3 till the place which performs motion adaptation processing and obtains an average noise level in the average noise level detector 712.

[0081] This noise reduction equipment has the motion vector detector 708 which detects the video-signal lost-motion vector of which 1 field +beta delay was done by the 1st field memory 709 which accumulates the 1 field of video signals inputted from the input terminal 701, the video signal sent from the input terminal 701, and the 1st field memory 709.

[0082] Moreover, noise reduction equipment has the 2nd field memory 705 which accumulates the 1 field of video signals outputted from an output terminal 707, and the memory controller 706 which controls the 2nd field memory 705 based on the motion vector detected in the motion vector detector 708. The 2nd field memory 705 outputs the video signal of which 1 field +alpha delay was done.

[0083] Furthermore, noise reduction equipment has the 1st subtractor 704 which subtracts the video signal sent from the 2nd field memory 705 from the video signal sent from the 1st field memory 709, the Hadamard transform circuit 710 which changes into a frequency band the differential signal sent from the 1st subtractor 704 by the Hadamard transform, and the nonlinear-processing circuit 703 which performs nonlinear processing to the signal sent from the Hadamard transform circuit 710 for every frequency band.

[0084] From the 2nd field memory 705, the video signal of which 1 field +alpha delay was done is outputted based on the motion amendment control signal from

the memory controller 706 based on the motion vector obtained in the motion vector detector 708.

[0085] In the 1st subtractor 704, the field differential signal of the video signal which was outputted from the 2nd field memory 705 and of which 1 field +alpha delay was done, and the video signal which was sent from the 1st field memory 709 and of which 1 field +beta delay was done is acquired. This field differential signal is inputted into the Hadamard transform circuit 710 from the 1st subtractor 704.

[0086] The Hadamard transform circuit 710 performs Hadamard transform processing, and divides a field differential signal to a predetermined frequency component.

[0087] The nonlinear-processing circuit 703 can process N individual corresponding to the limiter level of the noise level detector 713 classified by frequency. In the nonlinear-processing circuit 703, nonlinear processing according to the limiter level of N phase where it was inputted from the noise level detector 713 classified by frequency is chosen from processing of N individual, and nonlinear processing is performed.

[0088] And noise reduction equipment has the 2nd subtractor 702 which reduces the video signal sent from the reverse Hadamard transform circuit 711 from the reverse Hadamard transform circuit 711 which performs a reverse Hadamard

transform to the signal of the frequency band to which nonlinear processing was performed in the nonlinear-processing circuit 703, and is changed at the real time, and the video signal sent from the 1st field memory 309.

[0089] It passes along the nonlinear-processing circuit 703, and the noise component for every frequency component extracted as a noise is returned to the signal on a time-axis by the reverse Hadamard transform circuit 711. The output signal of the reverse Hadamard transform circuit 711 is supplied to a subtractor 702, and is subtracted from an input video signal with the 2nd subtractor 702.

[0090] And noise reduction equipment has the noise level detector 713 classified by frequency which detects the noise level according to frequency from the signal of the frequency band sent from the average noise level detector 712 which detects an average noise level based on the detection result in a motion vector 708, and the average noise level detector 712 and the Hadamard transform circuit 710, and controls the nonlinear-processing circuit 703.

[0091] The field differential signal for every frequency component outputted from the Hadamard transform circuit 710 is inputted into the noise level detector 713 classified by frequency. The average noise level obtained in the average noise level detector 712 is inputted into the noise level detector 713 classified by frequency, and effective / invalid judging result of the detection for every block

are inputted into it from the motion vector detector 708. And the noise level about each frequency component is measured, and it changes and outputs to the limiter level of N phase, and inputs into the nonlinear-processing circuit 703.

[0092] namely, the difference after the Hadamard transform of the block which the noise level detector 713 classified by frequency made the reference the noise level detected in the average noise level detector 712, reextracted the block of only a noise level again, and was extracted -- it asks for the average of a value according to a frequency.

[0093] on the other hand, the average noise level detector 712 -- the block of only a noise component -- extracting -- difference -- one noise level is detected in the field from a value.

[0094] Next, in the noise level detector 713 classified by frequency, how to output the limiter level according to the noise level of each frequency band is explained using drawing 8 .

[0095] The absolute value processing section 805 performs absolute value processing to the field differential signal 803 acquired from the Hadamard transform circuit 710.

[0096] The equalization section 806 is offset alphaF to the average noise level 802 which is the block judged that is effective from effective / invalid judging result 801 for every block obtained from the motion vector detector 708, and was

obtained from the average noise level detector 713. The minimum value of the difference of block matching obtained from the motion vector detector 708 to the applied value adds only the field differential signal of only a small block, and takes and outputs the average. It means outputting the noise component of only the block with an average noise component for every frequency component by this.

[0097] here -- the average noise level 802 -- offset alphaF the difference according to a noise by the location of the block which matched since having added was not fixed as for the magnitude of a noise and it contained a changed part -- it is because the values of a value differ. alphaF It is a changed part of this noise component, and the amount of this fluctuation is proportional to the magnitude of a noise. For example, when A is made into a constant, it is an alphaF =Ax average noise level.

[0098] The noise extracted in the equalization section 806 is inputted into a filter 807 about each frequency component, and the same processing as the filter 405 which performs IIR mentioned above is made. The accuracy 804 of the noise level determined in the accuracy decision section of noise level detection of the average noise level detector 712 is inputted into a filter 807, and the property of a filter changes with these accuracy like the above-mentioned filter 405.

[0099] The noise level outputted from the filter 807 is inputted into the limiter

level-conversion section 808, and is changed into the limiter level 809 of the strength of N phase.

[0100] In addition, although the example applied to the gestalt of operation of the 2nd of noise reduction equipment about the approach of outputting limiter level was shown, also in the gestalt of operation of the 1st of noise reduction equipment, limiter level can be outputted here using the same configuration. In the gestalt of operation of the 2nd of noise reduction equipment, the inputted noise is extracted according to a frequency band, the optimal nonlinear-processing circuit according to each noise level is chosen as automatic, and noise reduction according to the strength of the noise of each frequency band is performed.

[0101] Moreover, in the gestalt of operation of the 2nd of noise reduction equipment, time filtering processing was performed after the noise extract, and time fluctuation of a noise level is graduated.

[0102] Next, other examples of a noise level detector are explained using drawing 9 . This noise level detector is applied to the noise level detector 310 in the noise reduction equipment shown in drawing 3 , and the average noise level detector 712 of the noise reduction equipment shown in drawing 7 .

[0103] the difference of the vector (0 0) by block matching in the area where this noise level detector has the small contrast of an image -- it uses that a value is

the difference by the noise component. Here, a vector (0 0) is a zero vector about block matching about the search range of a direction (x y). for example, the difference of block matching obtained from the motion vector detector 308 -- the average value 901 of a value, and the difference of a vector (0 0) -- the difference of a value -- a value 902 is inputted into the minimum value detecting element 903. the difference of the vector out of the block which fills with the minimum value detecting element 903 the conditions that the contrast of an image is small, smaller than a threshold value with this average (0 0) -- it asks for the min of a value.

[0104] This minimum value is outputted from the motion vector detector 308 as a noise level in this field. In addition, it is very good in the average of the minimum value in each area which could calculate the one minimum value in the field, could take two or more minimum values as detection of the minimum value in the minimum value detecting element 903, and was divided in the field.

[0105] The relation with the noise level detector shown in drawing 3 of this noise detection approach is as follows. That is, the minimum value as a result of both may be taken.

[0106] Moreover, when there are many service areas of a motion vector, the detection approach using the service area of the detection result of a motion vector is performed, and when there are few service areas, switch of using the

detection approach using the block with small contrast may be performed.

[0107] Furthermore, when there is much block count with small contrast, switch of using the detection approach conversely using the service area of a motion vector detection result may be performed using the detection approach using the block with small contrast.

[0108] Next, in the noise level detector 713 classified by frequency, other approaches of outputting the limiter level according to the noise level of each frequency band are explained using drawing 10 .

[0109] the difference of the vector (0 0) in the area where this approach has the small contrast of an image -- it is used for a value that it is the difference by the noise component.

[0110] the difference of block matching for every block obtained from the motion vector detector 708 by the equalization section 1005 -- the difference of the average value 1001 of a value, and the vector (0 0) of block matching -- a value 1002 and the average noise level 1000 obtained from the average noise level detector 712 are inputted. the value which added the fluctuation part alpha of a noise level to the average noise level 1000 -- the difference of a vector (0 0) -- a value 1002 -- small -- and difference -- the average value 1001 of a value adds the field differential signal 1003 after the Hadamard transform of only a block smaller than a threshold value for every frequency component, takes an average,

and outputs from 1006.

[0111] The value of a threshold is a value according to the value of the average noise level 1000. For example, it is the search range (xxy) x constant A of an average noise level x motion vector.

[0112] The relation with the noise level detection approach according to frequency band shown in drawing 8 is as follows. That is, addition and an average may be performed about all blocks judged to be effective by both approach.

[0113] Moreover, these approaches may be switched for every ** field by the case where there is much block count obtained by the detection approach using the service area of the detection result of a motion vector, and the case of being few.

[0114] Furthermore, these approaches may be switched by the case where there is much block count obtained by the detection approach using the small block of contrast, and the case of being few. As mentioned above, in a field round mold noise reduction circuit, by extracting the highly precise noise component except a motion, and choosing the optimal nonlinear-processing circuit according to a noise level as automatic, automatically, it can carry out and the gestalt of this operation performs highly precise adjustment for adjustment of the noise reduction effectiveness.

[0115] Next, the noise reduction equipment which prepared the detection with a beam of every image unit (the field or frame) is explained to the noise level detector in a noise reduction circuit as a gestalt of operation of the 3rd of this invention, referring to drawing 11 . Since the whole noise reduction equipment configuration used as the gestalt of this 3rd operation is the same as that of drawing 2 and drawing 7 which were mentioned above, it is not illustrated but omits explanation.

[0116] In the noise reduction equipment of the gestalt of this 3rd operation, a configuration as shown in drawing 11 is used as the noise level detector 310 of above-mentioned drawing 2 , the average noise level detector 712 of above-mentioned drawing 7 , and a noise level detector 713 classified by frequency.

[0117] In drawing 11 , effective / invalid judging result 321 for every block obtained from the motion vector detector 308 of above-mentioned drawing 2 or the motion vector detector 708 of above-mentioned drawing 7 , and the minimum value 322 of the difference of motion vector detection are inputted into the minimum value detecting element 325. In the minimum value detecting element 325, the minimum value is calculated further, using only the minimum value of the difference of the block judged that is effective in motion vector detection. The minimum value outputted from the minimum value detecting element 325, i.e.,

an average noise level, is stretched and attached, it is inputted into the judgment circuit 330, and judges whether it existed with the beam in 1 image unit, for example, the field.

[0118] threshold alphaH predetermined [as this algorithm / in / it stretches and attaches and / the judgment circuit 330] in the above-mentioned average noise level what is made into a **** with a beam when small -- it is -- this -- the field -- since difference is taken, even if it is a still picture, it takes into consideration that an average noise level takes the value of a certain non-zero. namely, these criteria -- for example, average noise level < Threshold alphaH : stretching -- attaching -- it is -- average noise level >= Threshold alphaH : It stretches and attaches, and it can express so that it may be nothing.

[0119] **** with a beam / nothing signal which was judged by the judgment circuit 330 with a beam and was acquired are sent to a filter 327. This filter 327 carries out filtering of the average noise level from the minimum value detecting element 325, and **** with a beam / nothing signal from the above-mentioned judgment circuit 330 with a beam, and the accuracy of the noise level determined in the accuracy decision section 326 of noise level detection are inputted as a filter control signal. The example of this filter 327 is shown in drawing 12 .

[0120] In drawing 12 , the average noise level 421 from the above-mentioned minimum value detecting element 325 is sent to the multiplier multiplier 423, and

the output from the multiplier multiplier 423 is taken out as a noise level 427 through an adder 424. Through the unit delay element 426, through the multiplier multiplier 425, this noise level 427 is sent to an adder 242, and is added with the output from the multiplier multiplier 423. Here, adjustable control of the multiplication multiplier K of multiplication multiplier 1-K of this multiplier multiplier 423 and the multiplier multiplier 425 is carried out accommodative by the accuracy 422 of the noise level from the accuracy decision section 326 of the above-mentioned noise level detection, and the **** with a beam / nothing signal 429 from the above-mentioned judgment circuit 330 with a beam. As shown in said drawing 5 , the accuracy 422 of a noise level, and relation with a multiplier K specifically When stretch and attach, it is [it is made for filter factor K to decrease in monotone, and] and it considers as a **** with a beam with the /-less signal 429 as accuracy increases setting a multiplier K to 1 compulsorily and carrying out as [input / the average noise level 421 / set the multiplier (1-K) of the multiplier multiplier 423 to 0, and / in a filter] (the mask of the input signal being carried out -- as) is mentioned.

[0121] It returns to drawing 11 again, and the above-mentioned noise level 427 which is an output from a filter 327 is sent to the limiter level-conversion section 328, in this limiter level-conversion section 328, it is changed into the limiter level of N phase according to the noise level from a filter 327, and this limiter level 329

is taken out.

[0122] Next, the noise reduction equipment which was made to judge whether it was with the beam in the block as a gestalt of operation of the 4th of this invention is explained, referring to drawing 13 . In the noise reduction equipment of the gestalt of this 4th operation, a configuration as shown in drawing 13 is used as the noise level detector 310 of above-mentioned drawing 2 , the average noise level detector 712 of above-mentioned drawing 7 , and a noise level detector 713 classified by frequency. In addition, since the whole noise reduction equipment configuration used as the gestalt of this 4th operation is the same as that of drawing 2 and drawing 7 which were mentioned above, it is not illustrated but omits explanation.

[0123] In drawing 13 , effective / invalid judging result 521 for every block obtained from the motion vector detector 308 of above-mentioned drawing 2 or the motion vector detector 708 of above-mentioned drawing 7 , and the minimum value 522 of the difference of motion vector detection are inputted into the minimum value detecting element 525. Moreover, the minimum value 522 of the difference of motion vector detection stretches and sticks, is sent also to the judgment circuit 530, is stretched and attached, based on the minimum value 522 of the difference of motion vector detection, there is with [of each block] a beam, judges those without /, and has sent the judgment result to the minimum

value detecting element 525 in the judgment circuit 530.

[0124] As an algorithm in the judgment circuit 530 with a beam, the minimum value 522 of the difference of the above-mentioned motion vector detection is predetermined threshold betaH. When small, it considers as a **** with a beam. namely, these criteria The minimum value of the difference of motion vector detection < Threshold betaH : stretching -- attaching -- it is -- The minimum value of the difference of motion vector detection >= Threshold betaH : It stretches and attaches, and it can express so that it may be nothing. It takes into consideration that this stretches, attach and the minimum value of the difference of motion vector detection takes the value of a certain non-zero in the nothing condition.

[0125] In the minimum value detecting element 525, it is the block judged that is effective in motion vector detection, and the minimum value is calculated further, using only the minimum value of the difference of motion vector detection of the block judged as there being nothing with a beam. The minimum value outputted from the minimum value detecting element 525, i.e., an average noise level, is sent to a filter 507. The concrete example of a configuration of this filter 507 is shown in drawing 14 .

[0126] In this drawing 14 , the average noise level 621 from the above-mentioned minimum value detecting element 525 is sent to the multiplier multiplier 623, and the output from the multiplier multiplier 623 is taken out as a

noise level 627 through an adder 624. Through the unit delay element 626, through the multiplier multiplier 625, this noise level 627 is sent to an adder 642, and is added with the output from the multiplier multiplier 623. Here, adjustable control of the multiplication multiplier K of multiplication multiplier 1-K of this multiplier multiplier 623 and the multiplier multiplier 625 is carried out by the accuracy 622 of the noise level from the accuracy decision section 626 of the above-mentioned noise level detection accommodative. The thing from which accuracy specifically increases the accuracy 622 of a noise level and relation with a multiplier K as shown in said drawing 5 and which it is alike, therefore filter factor K decreases in monotone is mentioned.

[0127] It returns to drawing 13 again, and the above-mentioned noise level 627 which is an output from a filter 527 is sent to the limiter level-conversion section 528, in this limiter level-conversion section 528, it is changed into the limiter level of N phase according to the noise level from a filter 527, and this limiter level 529 is taken out.

[0128] According to the gestalt of these 3rd [the] and the 4th operation, by adding the circuit (stretching and attaching judgment circuit 330,530) which detects that it was in the input signal with the beam, the noise incorrect detection depended with [of a picture signal] a beam can be reduced, and good automatic-optimization noise reduction equipment can be realized.

[0129] Here, the gestalt of the above 1st of this invention - the 4th implementation can be applied, when recording / reproducing an image at record media, such as an optical disk and a magnetic tape, and transmitting images, such as a video conference system, a TV phone system, and a broadcast device, to a receiving side from a transmitting side through a transmission line, the noise reduction equipment (noise RIDEYUSA) of the round mold which reduces the noise in a digital video signal. Moreover, the gestalt of operation of this invention can reduce a noise effectively in each frequency band, even if the video signal of a big noise level is inputted, in order to use two or more nonlinear-processing circuits according to the noise level and frequency distribution which were inputted.

[0130] That is, with the gestalt of this operation, even if the video signal of a big noise level seen with the noise reduction equipment which will not be based on the noise level or frequency distribution which were inputted, but will be the requisite for the gestalt of this operation using the same nonlinear-processing circuit is inputted, the noise reduction effectiveness is low, or the problem that the noise reduction effectiveness of a certain frequency band is low is mitigated.

[0131] Moreover, with the gestalt of this operation, when the noise seen with the noise reduction equipment which will be the requisite for the gestalt of this operation hardly exists, the problem that the motion dotage of a block and the

low block of field correlation whose motion vector detection was not completed is conspicuous, or a noise increases conversely is mitigated.

[0132] In addition, in the gestalt of this operation, although the video signal was processed per field, this invention is not limited to this. This invention can also process a video signal per frame.

[0133] Moreover, in the gestalt of this operation, although the Hadamard transform was shown as an example of orthogonal transformation, this invention is not limited to this. This invention can also use other orthogonal transformation.

[0134]

[Effect of the Invention] According to this invention, by extracting the highly precise noise component excluding the motion from the field or an inter-frame differential signal, and choosing the optimal nonlinear-processing circuit according to this noise level as automatic, automatically, it can carry out and highly precise adjustment can be performed for adjustment of the noise reduction effectiveness.

[0135] according to this invention -- the field or inter-frame -- the noise reduction effectiveness according to distribution of a noise can be automatically performed by dividing difference into two or more frequency band components, extracting the highly precise noise component except a motion about each frequency band component, and choosing the optimal nonlinear-processing circuit according to

each noise level as automatic.

[0136] According to this invention, after a noise extract, since adaptive filter processing which changes the multiplier of a filter according to noise level detection accuracy has been performed, it is possible to perform smooth noise reduction in time.

[0137] Moreover, since he is trying not to use the signal for noise level detection according to this invention when it is in an input signal with a beam, noise incorrect detection can be prevented and good automatic-optimization noise reduction can be realized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the block diagram showing the rough configuration of a record regenerative apparatus.

[Drawing 2] It is the block diagram showing the configuration of the 1st of the gestalt of operation of noise reduction equipment.

[Drawing 3] It is a block diagram for explaining a noise level detector.

[Drawing 4] It is a circuit diagram explaining filtering in a noise level detector.

[Drawing 5] It is drawing showing the relation between filter coefficient K in a noise level detector, and the accuracy of a noise level.

[Drawing 6] It is the block diagram showing the configuration which will be the requisite for the gestalt of operation of the 2nd of noise reduction equipment.

[Drawing 7] It is the block diagram showing the configuration of the 2nd of the gestalt of operation of noise reduction equipment.

[Drawing 8] It is a block diagram explaining the limiter level in noise reduction equipment.

[Drawing 9] It is drawing showing other examples of a noise level detector.

[Drawing 10] It is drawing showing other methods of detecting a noise level for every frequency band.

[Drawing 11] It is the block diagram showing an example of the noise level detector used as the important section of the noise reduction equipment of the gestalt of operation of the 3rd of this invention.

[Drawing 12] It is the block diagram showing the concrete example of a configuration of the filter in the noise level detector of drawing 11 .

[Drawing 13] It is the block diagram showing an example of the noise level detector used as the important section of the noise reduction equipment of the gestalt of operation of the 4th of this invention.

[Drawing 14] It is the block diagram showing the concrete example of a

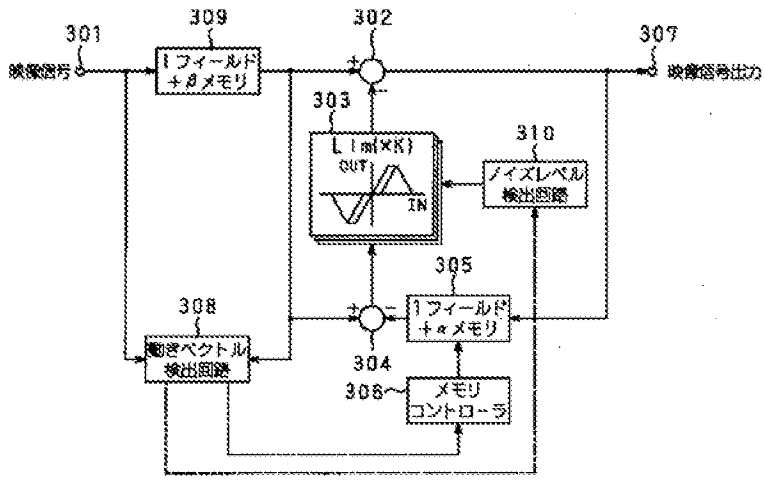
configuration of the filter in the noise level detector of drawing 13 .

[Drawing 15] It is the block diagram showing the configuration of conventional noise reduction equipment.

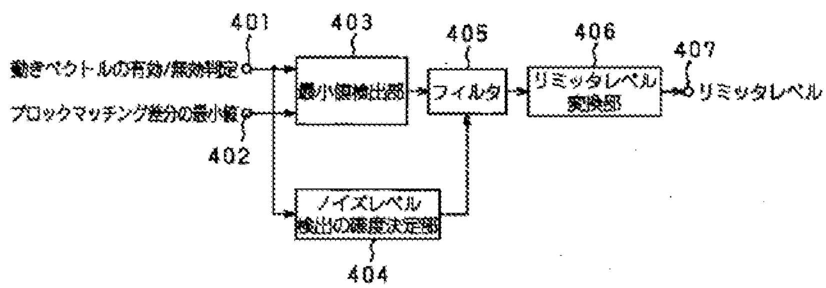
[Description of Notations]

303,703 Nonlinear-processing circuit 305,705 The 2nd field memory, 306,706 Memory controller 308,708 Motion vector detector, 309,709 The 1st field memory 310 Noise level detector, 325,403,525,903 Minimum value detecting element 326,404,526 The accuracy decision section of noise level detection, 327,405,527,905 Filter 328,406,528,906 The limiter level-conversion section, 330,530 It stretches and attaches and is a judgment circuit.

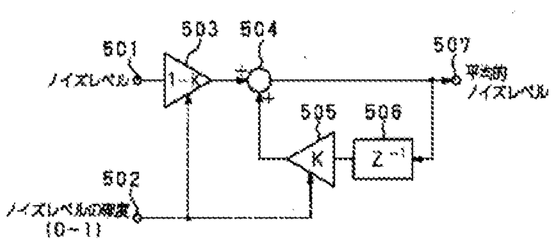
【図２】


301
309
302
307
映像信号
1フィールド
+βメモリ
映像信号出力
303
Lim(×K)
OUT
IN
310
ノイズレベル
検出回路
305
308
1フィールド
+αメモリ
動きベクトル
検出回路
304
306
メモリ
コントローラ

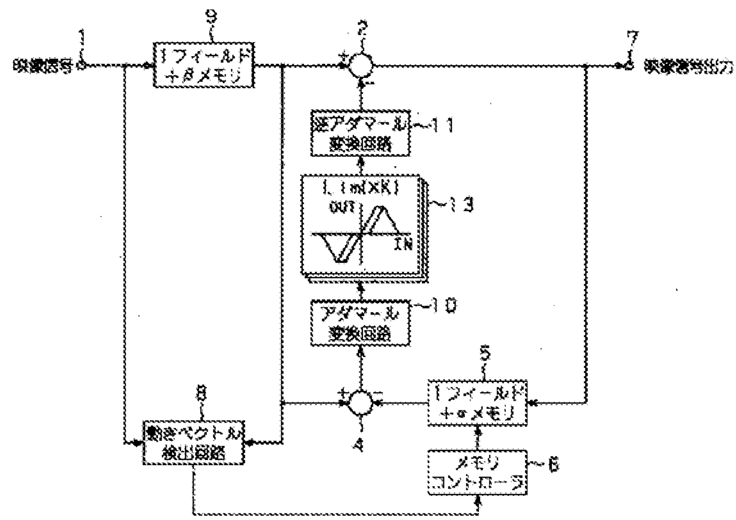
【図３】


401
403
405
406
407
動きベクトルの有効/無効判定
最小値検出部
フィルタ
リミッタレベル
変換部
リミッタレベル
ブロックマッチング差分の最小値
402
ノイズレベル
検出の確度決定部
404

【図４】

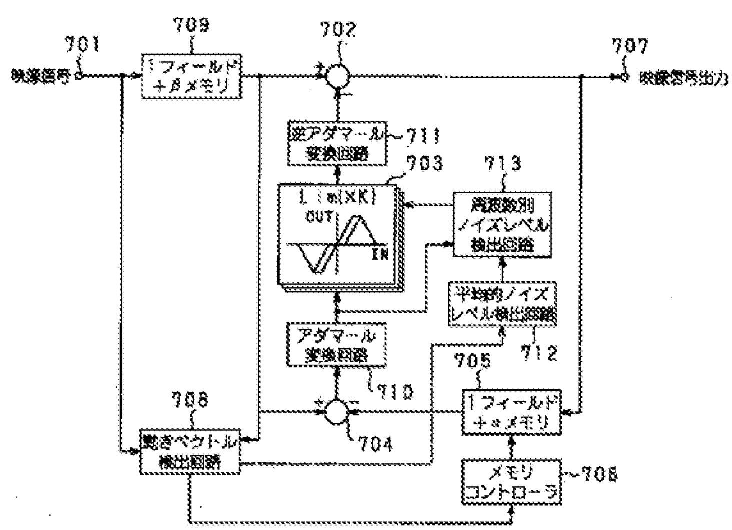

501
503
504
507
ノイズレベル
1-K
平均的
ノイズレベル
505
506
K
Z^{-1}
502
ノイズレベルの確度
(0~1)

【図６】



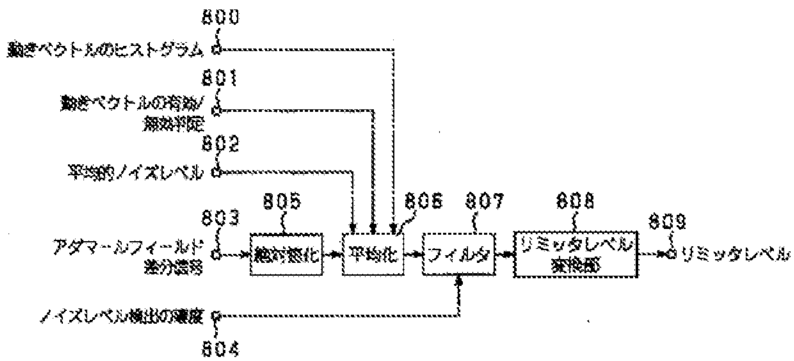
1
映像信号
9
1フィールド
＋βメモリ
2
7
映像信号出力
逆アダマール
変換回路
11
Limit(K)
OUT
IN
13
アダマール
変換回路
10
5
1フィールド
＋αメモリ
8
動きベクトル
検出回路
4
メモリ
コントローラ
6

【図７】

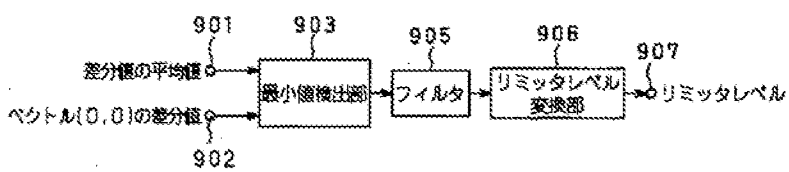


701
映像信号
709
1フィールド
＋βメモリ
702
707
映像信号出力
逆アダマール
変換回路
711
703
713
Limit(K)
OUT
IN
周波数別
ノイズレベル
検出回路
平均的ノイズ
レベル検出回路
712
アダマール
変換回路
710
705
1フィールド
＋αメモリ
708
動きベクトル
検出回路
704
メモリ
コントローラ
706

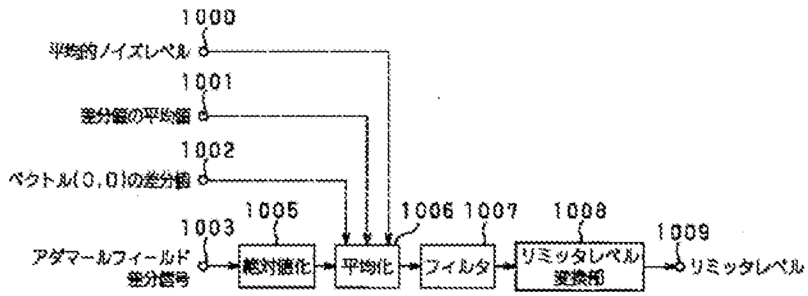
【図８】


800
動きベクトルのヒストグラム
801
動きベクトルの有効/無効判定
802
平均的ノイズレベル
803
アダマールフィールド差分信号
805
絶対値化
806
平均化
807
フィルタ
808
リミッタレベル変換部
809
リミッタレベル
ノイズレベル検出の確度
804

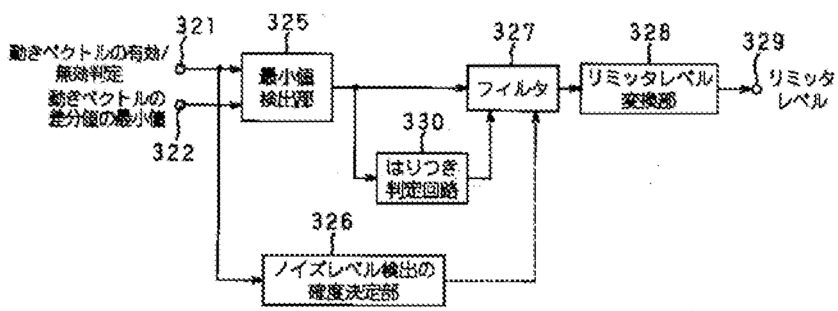
【図９】


901
差分値の平均値
902
ベクトル(0,0)の差分値
903
最小値検出部
905
フィルタ
906
リミッタレベル変換部
907
リミッタレベル

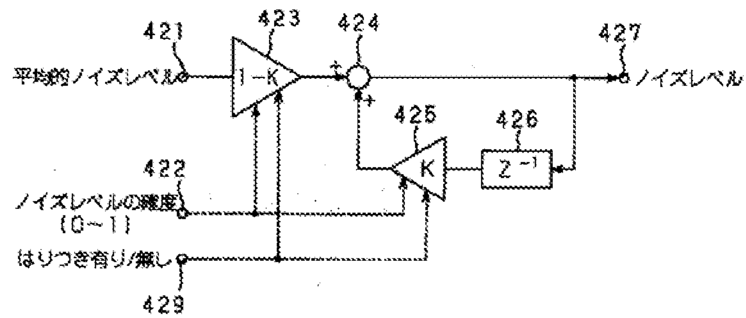
【図１０】


1000
平均的ノイズレベル
1001
差分値の平均値
1002
ベクトル(0,0)の差分値
1003
アダマールフィールド
差分信号
1005
絶対値化
平均化
1006
1007
フィルタ
1008
リミッタレベル
変換部
1009
リミッタレベル

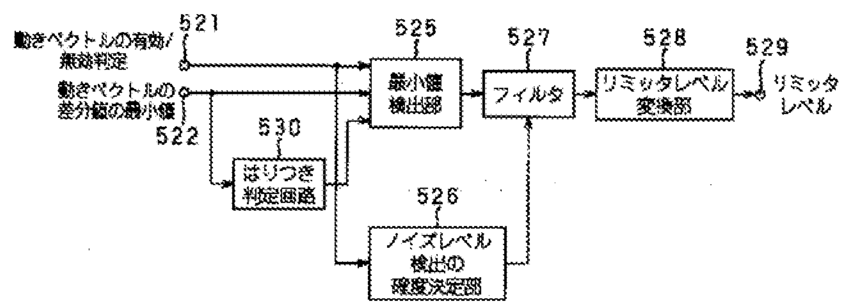
【図１１】


321
動きベクトルの有効/
無効判定
動きベクトルの
差分値の最小値
322
325
最小値
検出部
327
フィルタ
328
リミッタレベル
変換部
329
リミッタ
レベル
330
はりつき
判定回路
326
ノイズレベル検出の
確度決定部

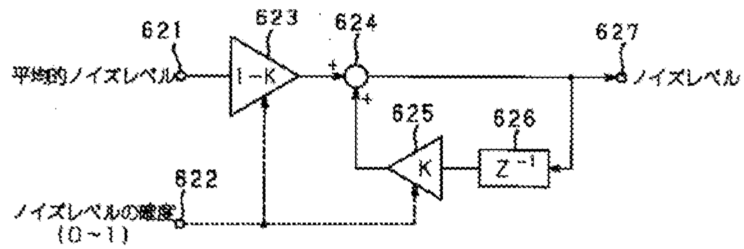
【図１２】


421
423
424
427
平均的ノイズレベル
1－K
ノイズレベル
425
426
K
Z^{-1}
422
ノイズレベルの確度
（0～1）
はりつき有り/無し
429

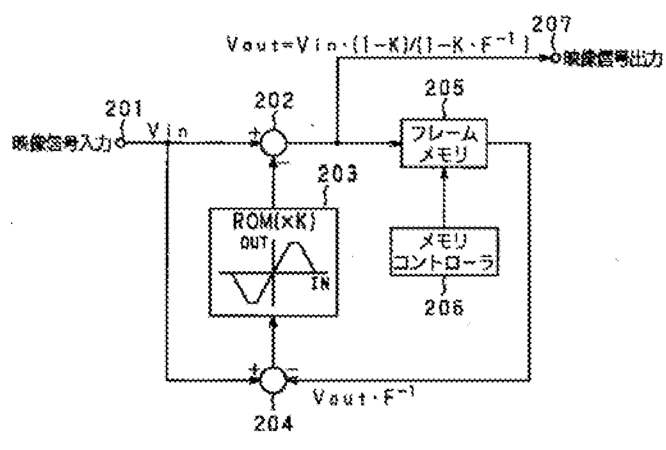
【図１３】


動きベクトルの有効/無効判定
521
525
527
528
529
動きベクトルの差分値の最小値
522
最小値検出部
フィルタ
リミッタレベル変換部
リミッタレベル
530
はりつき判定回路
526
ノイズレベル検出の確度決定部

【図１４】



【図１５】



フロントページの続き

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Ｆターム(参考)　5C021 XA01 XA43 XB12 YA02 YC00
5C053 FA23 FA27 GA11 GB19 GB37
HA09 KA03 KA11 KA16 KA22
KA24 KA25